

**METHODS AND APPARATUS FOR BIOLOGICAL TREATMENT
OF WASTE WATERS**

ABSTRACT OF THE DISCLOSURE

In a vertical shaft bioreactor, improved devices and methods are provided
5 for enhanced secondary and/or tertiary treatment of wastewater, including residential,
municipal and industrial wastewater. The devices and methods of the invention are
useful for enhanced secondary wastewater treatment, including BOD and TSS removal.
Tertiary treatment can alternately or additionally be achieved in the bioreactor with
nitrification of ammonia, with nitrification and denitrification, and with nitrification,
10 denitrification, and chemical phosphorus removal. A vertical shaft bioreactor is also
provided which achieves thermophilic aerobic digestion and pasteurization of sewage
sludges, optionally to produce class A biosolids.